to loop plant capacity.[12] Centrex lines in excess of their PBX trunk equivalents are appropriately removed from the analysis because they represent competitive (non-basic) service lines that are used for intercommunication purposes that would not exist under the (basic service) PBX trunk alternative.

In estimating available capacity for the RBOCs, "DSPC Lines Served"[13] and "Total Equipped Channels"[14] were selected as the measures of digital CO switching and loop plant capacity, respectively. These estimates of digital CO and loop capacity taken from ARMIS, however, are not true measures of capacity, but rather reflect lines (or channels) ready to serve. Dark fiber and excess digital switch processor capacity,[15] for example, would not be included in such measures. Accordingly, in order to approximate a more accurate (and realistic) measure of capacity for digital CO plant and loop plant, we develop a separate capacity adjustment factor for each plant group to apply to the raw line and channel counts taken from ARMIS. A conservative adjustment for digital CO capacity was developed based upon the most recent actual reported capacity data provided by Pacific Bell to the California Public Utilities Commission.[16] A similarly conservative adjustment for outside plant was developed based upon information available from the latest FCC Fiber

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12. As described in ARMIS Report Definitions, Row 370 - *Total Working Channels* - are counted on a 4 kHz bandwidth (single voice channel) basis. Working channels originating from a remote switch are treated the same as if the channels originated in the host central office. "Total Working Channels" are equal to the sum of rows 380 *Total Copper* (the number of copper working channels), 390 *Fiber Digital CXR* (the number of fiber digital CXR [carrier] working channels, converted to voice frequency equivalents) and 410 *Other* (other working channels). Whereas the "Total Number of Access Lines in Service" measure includes only switched lines, the "Total Working Channel" counts include non-switched loop plant in addition to switched. FCC ARMIS Infrastructure Report 43-07, Report Definitions, Row Instructions, August 1993.

13. As described in ARMIS Report Definitions, Row 180 *DSPC Lines Served* is defined as the number of lines served by Digital Stored Program Controlled switches, rounded to the nearest thousand. *Id.*

14. As described in ARMIS Report Definitions, Row 420 *Total Equipped Channels* - are counted on a 4 kHz bandwidth (single voice channel) basis. Equipped channels originating from a remote switch are treated the same as if the channels originated in the host central office. "Total Equipped Channels" are equal to the sum of rows 430 *Copper* (the number of copper equipped channels), 440 *Fiber Digital CXR* (the number of fiber digital CXR equipped channels) and 460 *Other* (other equipped channels). *Id.*

15. A digital CO switch central processor may have a capacity of up to 100,000 lines, but the machine may only be "equipped" for a far smaller number, for example, 40,000 lines. ARMIS capacity data will reflect only the smaller (i.e., most limiting) of these two capacities.

16. Pacific Bell Monitoring Report, P.E—01—00 for digital CO capacity. We applied a capacity adjustment factor of 7.5 percent, i.e., we grossed up DPSC Lines in Service data from ARMIS by 7.5%. Note that the Pacific Bell report is also based upon "most limiting capacity" and hence does not report excess capacity in other switch components, such as the central processor.

Deployment Update and from general industry knowledge.[17] Applying these adjustment factors yields a second set of digital CO growth and loop growth figures that are more appropriately analyzed in relationship to the corresponding growth in access lines and working channels.

The respective growth levels for each of these measures is calculated by subtracting the 1990 reported figures from the corresponding 1994 data. Once the growth levels are obtained, we develop plant addition utilization factors (i.e., the percentages of digital CO capacity and loop growth, respectively, that can be explained by growth in demand) by dividing access line growth by the growth in DSPC lines served (to derive the percentage of added digital CO capacity that is demand driven), and by dividing working channel growth by the growth in equipped channels (to derive the percentage of loop growth that is demand driven).

Application of utilization data to investment figures

The utilization percentages estimated in the preceding step are now applied to the actual 1990-1994 plant additions to derive the amount of plant additions that appear to have been driven by growth in basic service demand. Investment data is taken from ARMIS Form 43-02 reports for Account 2212 Digital Electronic Switch (for digital CO plant) and Account 2410 Cable & Wire (for loop plant). Estimates of demand-driven plant additions are calculated by multiplying the dollar amounts of the plant additions by the percentage of capacity that is driven by demand, as determined in the preceding step. Since revisions to plant additions will also impact the levels of retirement of plant, we also calculate revised retirement amounts that correspond to the revised new plant additions. The method employed maintains the same proportion of retirements to additions in any given year.

In a few instances, utilization percentages estimated for outside plant facilities were negative, indicating that additional outside plant facilities were deployed despite the fact that the RBOC experienced an overall decline (i.e., negative growth) in basic service demand over the period. In such cases, to be conservative and because some portion of the additions our methodology would treat as excess capacity may be necessary to support basic service demand even in an overall negative growth environment (e.g., plant replacements caused by normal wear and tear of plant used to serve basic demand, and/or the non-fungibility of plant due to geographic shifts in demand), we set a floor below which we do not reduce additions. Specifically, in no case do we reduce plant additions by more than

17. See, Kraushaar, Jonathan M., *Fiber Deployment Update: End of Year 1994*, Industry Analysis Division, Common Carrier Bureau, F.C.C., July 1995. For Loop growth, we used a capacity adjustment factor of 25%, i.e., we grossed up the Total Equipped Channel data available from ARMIS by 25%.

90%, i.e., we assume ILECs could justify a base level of additions of 10% of their actual levels as being required to support the existing base of basic service demand even under zero- or negative-growth conditions.

Calculation of revised net TPIS results for the post-1990 period

The revised additions and revisions data are then input into our vintage analysis model, which is then used to calculate revised net TPIS amounts for the 1990 to 1995 period. Based upon these revised net TPIS amounts, we can then estimate the amount by which TPIS for any given ILEC is overstated as a result of investments made for purposes other than the satisfaction of basic demand growth.

The utilization analysis worksheets are reproduced in Appendix C to this Study.

3 RESULTS OF THE EMPIRICAL ANALYSIS

Vintage Analysis

The vintage analysis determines the relative age of ILEC net book investment in order to test the validity of ILEC claims that large amounts of obsolete plant — acquired at a high cost relative to today's prices — remain in the ILECs' embedded rate base.

As shown in Table 1 on the following page, the results of the vintage analysis confirm that the majority of current ILEC net plant in service is relatively new, representing investments that were made by the ILECs during the post-1990 period. As of the end of 1995, in a pattern quite consistent across the RBOCs as well as SNET, 60% of the net TPIS can be attributed to plant vintages of 1990 or later. This finding specifically refutes the notion implicit in arguments advanced by the ILECs that a large embedded base of old and obsolete plant is responsible for creating a divergence from TSLRIC results.

As Table 1 demonstrates, the amount of net TPIS falling in the category of post-1990 vintage plant is substantial. As of the end of 1995, of total RBOC net TPIS of $119.5-billion, approximately $71.4-billion relates to plant deployed in 1990 or later, while only $48.1-billion relates to plant deployed prior to January 1, 1990. At the beginning of 1990, net TPIS for the RBOCs stood at $117.4-billion,[18] such that by the end of 1995, the amount of older (i.e., pre-January 1, 1990) net plant remaining on the RBOCs' books had fallen by some $69.3-billion — roughly equivalent to the amount RBOCs had added to net plant in the post-1990 period.

18. Derived in ETI Vintage Analysis (Appendix A), using FCC ARMIS (USOA) Report 43-02, Table B1.

Table 1

The majority of current ILEC net plant in service is relatively new.

Investment and Percentage of Net TPIS Attributed to Pre- and Post-January 1, 1990 Periods, as of the end of 1995

RBOCs	Net TPIS Year End 1995 ($000)	Net TPIS Attributed to Pre 1-1-90 Vintages ($000)	Percent	Net TPIS Attributed to Post 1-1-90 Vintages ($000)	Percent
Ameritech	$14,874,907	$6,694,965	**45.0%**	$8,179,942	**55.0%**
Bell Atlantic	$18,126,694	$7,503,364	**41.4%**	$10,623,330	**58.6%**
BellSouth	$22,990,452	$8,437,811	**36.7%**	$14,552,641	**63.3%**
Nynex	$16,800,636	$6,296,223	**37.5%**	$10,504,413	**62.5%**
Pacific Telesis	$14,629,943	$6,235,511	**42.6%**	$8,467,997	**57.9%**
SBC Communications	$15,116,818	$6,763,120	**44.7%**	$8,353,698	**55.3%**
US West	$16,935,629	$6,173,582	**36.5%**	$10,762,047	**63.5%**
TOTAL RBOC	$119,475,079	$48,104,576	**40.3%**	$71,444,068	**59.8%**
SNET	$2,146,681	$872,912	**40.7%**	$1,273,769	**59.3%**

Source: ETI Vintage Analysis, Appendix A: Data from ARMIS Report 43-02.

Moreover, as shown in Table 2 on the following page, the results of the vintage analysis further demonstrate that in the aggregate, newer vintage plant is replacing the older vintages at the steady pace of approximately 5%-10% per year. Thus, in the next several years, during the transition to a more competitive local exchange environment, the ILECs will have replaced or retired a substantial portion of their older vintage plant. Projecting out only a few more years, the percentage of pre-1990 plant is likely to fall in the range of only 25% to 30%. Further, as discussed below in the context of the composition analysis we performed, those categories of older vintage plant remaining on the companies' books consist disproportionately of plant that is neither economically nor technologically obsolete. While the specific percentages vary, the results across companies are quite similar.

Table 2

Over the next few years, the ILECs will have replaced most of their embedded base consisting of older vintage plant.

Yearly Change in Percentage of TPIS Attributed to Pre- and Post-January 1, 1990*

	Ameritech	Bell Atlantic	BellSouth	NYNEX	Pacific	SBC	US West	SNET
Year End	Pre/Post	Pre/Post	Pre/Post	Pre/Post	Pre/Post	Pre/Post	Pre/Post	Pre/Post
1989	100%/0%	100%/0%	100%/0%	100%/0%	100%/0%	100%/0%	100%/0%	100%/0%
1990	88.6%/11.4%	86.7%/13.3%	86.8%/13.2%	87.1%/12.9%	88.9%/11.1%	92.0%/8.0%	88.3%/11.7%	84.5%/15.5%
1991	77.8%/22.2%	75.6%/24.4%	75.0%/25.0%	76.5%/23.5%	78.4%/21.6%	83.6%/16.4%	76.2%/23.8%	73.5%/26.5%
1992	68.6%/31.4%	66.6%/33.4%	65.3%/34.7%	65.9%/34.1%	69.0%/31.0%	74.4%/25.6%	64.5%/35.5%	63.7%/36.3%
1993	59.9%/40.1%	58.0%/42.0%	55.2%/44.8%	56.1%/43.9%	60.0%/40.5%	65.9%/34.1%	54.8%/45.2%	55.7%/44.3%
1994	52.5%/47.5%	49.9%/50.1%	45.7%/54.3%	46.4%/53.6%	51.5%/49.0%	57.7%/42.3%	45.5%/54.5%	48.2%/51.8%
1995	45.0%/55.0%	41.4%/58.6%	36.7%/63.3%	37.5%/62.5%	42.6%/57.9%	49.6%/50.4%	36.5%/63.5%	40.7%/59.3%
1996 est.	39.4%/60.6%	35.7%/64.3%	31.1%/68.9%	31.9%/68.1%	37.0%/63.5%	44.1%/55.9%	30.9%/69.1%	35.0%/65.0%
1997 est.	34.5%/65.5%	30.9%/69.1%	26.3%/73.7%	27.1%/72.9%	32.1%/68.4%	39.3%/60.7%	26.1%/73.9%	30.2%/69.8%

* Net TPIS values for Pacific Telesis in years 1993-1997 slightly exceed 100% due to data discrepancy in ARMIS.
Source: ETI Vintage Analysis, Appendix A.

The vintage analysis thus provides clear empirical evidence that, contrary to ILEC claims and other "conventional wisdom," the existence of a "gap" between historical embedded costs and LRIC results *cannot* be ascribed to the obsolescence of plant put in place to satisfy growth in basic service demand. Rather what we see is that the majority of plant carried on the ILECs books was deployed during the 1990s — a time period in which fundamental regulatory changes, competitive inroads, and corresponding strategic responses, were clearly being contemplated and addressed by the ILECs.

Composition Analysis

From the composition analysis, which examines data at the plant account level, we glean important information concerning the composition of the ILEC installed base as between older and newer vintage plant. Specifically, we look for patterns with respect to the relative economic value of older versus newer vintage plant, and in particular, for the types of older plant surviving on the ILECs' books, whether similar plant is being acquired today, and if so, how current reproduction costs (such as reflected in TSLRIC results) compare to original historic acquisition costs.

Table 3

A much greater proportion of older vintage plant is surviving for plant categories for which current costs may be higher than historical embedded costs.

Range across RBOCs of Percentage of Plant Surviving (as of the end of 1995) for Largest State Operating Area

	Pre 1-1-90	Post 1-1-90
Cable-Metallic	64.5%-80.5%	19.5%-35.5%
Buildings	69.2%-84.4%	15.6%-30.8%
Conduit	69.8%-83.2%	16.8%-30.2%
Poles	70.1%-83.5%	16.5%-29.9%
Total RBOC Net TPIS from Table 1	40.3%	59.8%

Sources: Generation Arrangements of Ameritech–IL, Bell Atlantic–PA, BellSouth–FL, NYNEX–NY, Pacific Bell–CA, Southwestern Bell–TX, and US West–CO.

The results of the composition analysis confirm that for plant accounts such as metallic (i.e. copper) cable, building, conduit, and poles, for which, as discussed further below, current reproduction costs may be higher than historical embedded costs, there is a markedly greater proportion (in most cases, roughly double) of older vintage plant surviving as compared with the aggregate vintage results.

As shown in Table 3, the percent of pre-1990 plant surviving for metallic cable and building plant accounts ranges from 60% up to 80%. Similarly, for poles and conduit, a relatively large proportion of plant surviving, in the range of 70% to 80%, is associated with older vintage plant. For RBOC net TPIS overall, the comparable proportion of older vintage plant surviving is only 40% (as found in ETI's vintage analysis).

Table 4

Four types of plant for which current costs may exceed historical embedded costs are a significant component of net TPIS.

Net Investment of Plant in Service (as of the end of 1995)

Cable-Metallic	$34,566,728
Buildings	$13,295,385
Conduit Systems	$9,675,255
Poles	$1,464,195
Subtotal	$59,001,563
Total RBOC Net TPIS	$119,475,079

Sources: F.C.C. ARMIS Report 43-02; ETI Composition Analysis, Appendix B.

As shown in Table 4, the four types of plant highlighted in Table 3 represent roughly half of total RBOC net TPIS as of the end of 1995. However, because they consist disproportionately of older vintage plant, these plant categories will dominate the pre-1990 investment derived in the vintage analysis and shown in Table 1.

Thus, while the results of the vintage analysis demonstrate that the majority of the plant carried on the books of the ILECs is not in fact old, the composition analysis tells us that the types of plant comprising the older plant vintages have relatively high value to the ILECS, either because to acquire such plant may cost more today as compared with the time they were added, or because of their revenue-generating potential (as is the case with excess building space). It is well established that for certain technology-impacted ILEC capital inputs, such as digital switching systems and fiber optic cable, prices have been declining over time. However, for other inputs, such as copper cable, buildings, poles, and conduit, this is not the case. Current prices for these accounts generally exceed historic costs due to increases in both labor and material inputs.[19]

19. In the Commission's Price Cap Review proceeding, CC Docket 94-1, several parties including USTA, AT&T, and Ad Hoc Telecommunications Users Committee, relied upon various price indices to deflate capital asset categories of ILEC investment from annual current dollar expenditures into constant dollars. USTA originally relied upon Telephone Plant Indices (TPIs) developed by the ILECs, but subsequently switched to the asset price deflators developed by the Bureau of Economic Analysis (BEA) and Bureau of Labor Statistics (BLS) in response to Commission concerns regarding the proprietary nature of ILEC TPI data. The BEA/BLS indices were also relied upon in the AT&T and Ad Hoc analyses presented in Docket 94-1. Both the TPI and BEA/BLS data reveal that, relative to the prices paid by the ILECs for other kinds of telecommunications plant, the prices paid for plant in the categories encompassing metallic cable, buildings, poles, and conduit, increased significantly over the period 1984 to 1994. By contrast, the prices paid by the ILECs for plant in the categories encompassing general support, central office, transmission, and information origination/termination, either decreased or exhibited a slower rate of increase depending on the price index used. Moreover, both the TPI and BEA/BLS data grossly overstate the rate of price growth for these latter categories of plant because of their failure to adjust for changes in quality and/or capacity (so-called "hedonic" adjustments). Hedonic adjustments are particularly relevant for the high-technology capital inputs such as digital switching, digital electronics, and fiber optic transmission plant, whose characteristics have

(continued...)

Taken together, the vintage and composition results strongly suggest that in the next several years, during the transition to a more competitive local exchange environment, the ILECs will have replaced or retired virtually all categories of their pre-1990 embedded base of plant that has become economically and/or technologically obsolete.

Utilization Analysis

The two preceding analyses focused upon the vintage, or relative age, of ILEC embedded investment, at the aggregate and plant-account levels respectively, distinguishing between investment incurred in the pre- and post-1990 periods. In the utilization analysis, we further examine the post-1990 investment for the purpose of determining the portion of that aggregate investment that can be attributed to supporting growth in demand for basic service.

Table 5

Demand growth for basic service explains a relatively small fraction of recent ILEC central office and outside plant investment.

Percentage of Digital CO and Loop Capacity Additions Explained by Basic Service Demand Growth, 1990-1995

	Digital CO	Loop
Ameritech	12.3%	-15.8%
Bell Atlantic	18.7%	9.0%
BellSouth	33.8%	71.2%
NYNEX	15.3%	4.9%
Pacific Telesis	22.3%	33.2%
Southwestern Bell	34.8%	82.2%
US West	37.1%	66.0%
TOTAL RBOC	**23.7%**	**24.6%**

Sources: F.C.C. ARMIS Reports 43-07 and 43-08, 1990-1994; ETI Utilization Analysis, Appendix B.

As shown in Table 5, our utilization analysis demonstrates that, on balance, growth in demand for basic service is likely to explain only a relatively small fraction of ILEC central office and outside plant investment over the 1990-1995 period. As Table 5 indicates, there is a relatively consistent pattern across all RBOCs, with only in the range of 12% to 37% of digital central office capacity added over the period

19. (...continued)
evolved rapidly over time and reflect substantial technology-driven capacity and capability improvements. Hedonic adjustments do not apply to plant categories such as metallic cable, buildings, pole, and conduit, for which the nature of the input has been relatively stable. See Lee L. Selwyn, and Patricia D. Kravtin, *Establishing the X-Factor for the FCC Long-Term LEC Price Cap Plan*, CC Docket 94-1, prepared for the Ad Hoc Telecommunications Users Committee, December 1995, pp. 36-42; also Appendix B, Comparison of TPIs used in the Christensen Study with BEA/BLS Asset Deflators

January 1, 1990 through the end of 1995, that may be explained by growth in the demand for basic services.

There is a much broader range of results across RBOCs with respect to their utilization of gross added outside plant capacity. As shown in Table 5, utilization results range from as low as *negative* 16% (for Ameritech) to as high as 82% (for SBC Communications). Bell Atlantic and NYNEX utilized only about 5% to 10% of their added outside plant, while BellSouth and US West exhibit high utilization rates in the vicinity of 70%. Finally, Pacific Telesis used about 34% of the outside plant it added since January, 1990.

Several interesting observations can be made concerning these seemingly disparate results for utilization of the recently-acquired outside plant. First, for Ameritech, the negative utilization result indicates that this particular RBOC deployed additional outside plant facilities despite experiencing an overall decline (i.e., negative growth) in basic service demand over the period. While the ARMIS data for Ameritech show a relatively small, but positive, increase over the study period in the number of total working channels (the data used in the utilization analysis to measure basic service demand), this increase includes growth in *non-basic* Centrex lines. As discussed in Section 2 of this Study, the growth in non-basic Centrex lines is not appropriately treated as basic service demand growth, and must be excluded from the total working channel counts provided in ARMIS. Correspondingly, any increased outside plant additions motivated by the RBOCs' desire to compete in the PBX/Centrex market is appropriately recovered from Centrex services and not in the rates charged competitors for interconnection and unbundled network elements.

Second, companies exhibiting the lowest outside plant utilization, namely, Ameritech, NYNEX, and Bell Atlantic, operate in areas where regulatory and market conditions have historically been relatively conducive to competition. This is not generally the case for companies at the "high end" of outside plant utilization results. For example, SBC, the company exhibiting the highest outside plant utilization, is generally perceived to be operating in states that have, up to now, been more amenable to protecting ILEC markets and revenues from competition than have regulators in many other jurisdictions.[20] Moreover, SBC is known to be an aggressive investor in cellular and other out-of-region acquisitions. Accordingly, SBC's motivation for constructing excess outside plant capacity as part of a competitive response strategy may be less intense than for other, more competitively-impacted RBOCs. Similarly, the other two RBOCs experiencing relatively high utilization of their recently-acquired outside plant, BellSouth and US West, are also generally perceived to be operating in regions where regulatory and/or market conditions

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20. See Lesley Cauley, Steven Lipin, "Pacific Telesis, SBC Are Holding Talks For What Would Be First Merger of Bells," The Wall Street Journal, April 1, 1996, at A3-A4; also Albert R. Karr, "Texas defies Washington in Phone Deregulation, Protecting Its Local Bell Against Giant Rivals," The Wall Street Journal, May 2, 1996, at A16.

Table 6

A substantial amount of net investment cannot be explained by basic service demand growth.

($000 as of the end of 1995)

RBOCs	Actual Net TPIS Year End 1995	ETI Revised Net TPIS Year End 1995	Excess Net TPIS
Ameritech	$14,874,907	$10,514,608	$4,360,299
Bell Atlantic	$18,126,694	$13,522,224	$4,604,470
BellSouth	$22,990,452	$20,046,537	$2,943,915
Nynex	$16,800,636	$11,018,323	$5,782,313
Pacific Telesis	$14,629,943	$11,364,364	$3,265,579
Southwestern Bell	$15,116,818	$13,679,177	$1,437,641
US West	$16,935,629	$14,037,081	$2,898,548
Total RBOC	$119,475,079	$94,182,314	$25,292,765

Sources: F.C.C. ARMIS Report 43-02; ETI Utilization Analysis Results, Appendix C.

have (at least in the past) been less conducive to local competition. Moreover, US West, like SBC, has been aggressive in its pursuit of non-telephony business operations. In particular, US West has made relatively large financial commitments to out-of-region cable operations.

Third, even for these companies at the "high" end of the "demand-driven" outside plant utilization (i.e., estimates in the range of 66% to 82%) together with digital CO plant utilization estimates (averaging 24% for the RBOCs), suggest a substantial amount of historic investment that cannot be explained by basic service demand growth. On the basis of the utilization estimates shown in Table 5, we estimate for each of the RBOCs (and for the RBOCs overall) net TPIS (as of the end of 1995) that cannot be explained by growth in basic service demand. These results are presented in Table 6. For example, for BellSouth, an estimated loop plant utilization factor of 71% in conjunction with an estimated digital CO plant utilization factor of 34%, results in an estimated $2.9-billion in excess net plant relative to that required to satisfy growth in basic service demand over the 1990 to 1995 period.

As shown in Table 6, for RBOCs nationwide, we estimate in the order of magnitude of as much as $25-billion of net TPIS (as of the end of 1995) that cannot be explained by basic service demand growth. The results of this analysis suggest that a substantial amount of ILEC net plant placed in service during this period appears to have been motivated by other strategic goals and purposes.

We have considered other possible explanations of a portion of the excess investment identified in our utilization analysis. Specifically, the replacement of older plant, e.g., analog switching, with newer vintage plant (e.g., digital technology) could be economically justified for reasons other than meeting demand growth, either because of (1) operational cost savings that accompany the replacement, and/or (2) increased revenues associated with the offering of new services made possible by the replacement. With respect to the first potential explanation, we examined maintenance data for analog and digital switching plant over the period 1990 to 1995, but we find no evidence to date of operational cost savings in the form of reduced maintenance expense per unit. It is possible that it simply may be too soon for operational cost savings to manifest themselves, and that in the future as the changeover to digital plant is completed, such results could be observed. The emergence of such *future potential* operational cost savings, however, is simply not relevant for purposes of this analysis, since those future gains will flow to the RBOCs. Similarly, to the extent that the justification of plant deployment is attributed to the generation of new service revenues, the cost of that plant is properly attributable to the new services that motivated the deployment in the first place, and must not be recovered through rates charged to competitors for interconnection and unbundled network elements.

4 OTHER EXPLANATIONS AND SOURCES OF THE "GAP"

In addition to the quantitative evidence that we have presented here, there is strong anecdotal evidence of ILEC behavior that corroborates and underscores our analytical findings. In this Study, we address LEC strategic positioning (1) in the market for Centrex-type services with advanced features, (2) in the market for additional residential lines and other discretionary services, and (3) in the market for advanced and broadband digital services.

ILEC pursuit of the market for advanced Centrex-type services may have motivated the unnecessarily early replacement of analog central office switches and the excessive deployment of subscriber outside plant.

Centrex is an ILEC service offering that competes directly with customer premises PBX telephone systems that are offered by independent telecommunications equipment vendors. With Centrex, the switching functions are supported by a Class 5 central office switch located on the telephone company premises. As such, each individual Centrex station line requires a dedicated subscriber loop between the customer's premises and the CO for both interconnection and public network traffic. With a PBX, where the switching functions take place at the *customer's* site, the CO is involved only in public network traffic, which can be easily concentrated on a far smaller number of PBX trunks. Typically, a Centrex may require anywhere from 8 to 15 times as many loops as a comparably-sized PBX configuration.

To be competitive in this market, Centrex must provide advanced digital features comparable to those that are customarily offered in modern digital PBX switches and must be available for delivery/installation in approximately the same time frame as PBX vendors routinely offer to their customers. Participation in the Centrex/PBX (or more generally the "business telephone systems") market thus requires:

- that ILECs deploy advanced digital central office switches in sufficient quantity and with sufficient geographic diversity to respond to diverse customer demand in a timely manner; and

- that ILECs deploy and maintain sufficient excess outside plant capacity to accommodate in a timely manner the potential demand for the additional central office loops that are required to serve a Centrex customer over those that would be required where the customer subscribes for PBX trunks only.

The same digital central office switch that is required to support advanced Centrex features may also be used to provide "Plain Old Telephone Service" ("POTS") to core basic services customers. Thus, while an ILEC may be motivated to replace an older analog electronic central office switch with a digital machine primarily so that it can compete with digital PBX suppliers in the business telephone systems market, it can easily shift POTS customers from older machines to the new switch and thereby rationalize the investment for (and assign the majority of its costs to) POTS.

Also, in order for ILECs to be competitive in the Centrex/PBX market, they must have in place sufficient outside plant to support Centrex-level demand in whatever locations it may arise. Not surprisingly, ILEC outside plant construction guidelines typically require such intensity in commercial office buildings and similar locations. In other words, if the size of a building is capable of housing, for example, 5,000 employees, the ILEC will typically deploy 5,000 pairs of loop plant (plus additional spare capacity) to serve that building *whether or not the customer(s) in that building actually order Centrex.* Evidence submitted in CC Docket No. 96-98 by GTE indicates that Centrex has maintained a consistent market share (of the combined Centrex/PBX market) in the range of about 23% since 1992, with no diminution projected through 1997.[21] Thus, on average, in excess of four loops (plus even more for spare) will have been constructed and deployed for every *one* Centrex line that is actually placed in service. This conclusion is, of course, fully consistent with our own findings that a significant percentage of outside plant capacity additions made since January 1, 1990 was not required to support POTS growth.

The opportunity and potential for this type of misallocation portends to be substantially greater as ILECs initiate programs aimed at deploying broadband distribution infrastructures providing "fiber to the home" or "fiber in the loop" capacities, and pursue large-scale interactive information services ventures requiring greatly expanded network "intelligence." Here, the motivation behind such potentially massive investment programs is clearly entry into "new" broadband service markets and adjacent interactive information services and video entertainment fields. Yet if these broadband and intelligent network facilities are also *utilized* (whether or not actually *required*) to support conventional voice telephone services, an ILEC may be able to improperly assign a large share of the costs of its broadband plant

21. Doane, Michael J., J. Gregory Sidak and Daniel F. Spulber, *An Empirical Analysis of Pricing under Section 251 and 252 of the Telecommunications Act of 1996*, Attachment 4 to Comments of GTE Corporation, CC Docket No. 96-98, May 16, 1996, at II-16.

to, and recover those costs from, prices for its core local exchange telephone services and unbundled network elements.

This would not by any means be the first time that ILECs have constructed outside plant distribution networks with strategic, competitive goals in mind. In 1983, the California PUC found that Pacific Bell's plant utilization was inappropriately low, and imposed an explicit "underutilization penalty" on the Company that would remain in effect until the problem was corrected.[22] This phenomenon of underutilization also occurred throughout the Bell system. In the mid-1970s, the average loop plant utilization for the Bell System companies was reported to be in the range of 70%.[23] However, by the mid-1980s, subscriber outside plant (OSP) occupancy for the BOCs had noticeably declined. For example, the loop plant utilization reported by Pacific Northwest Bell - Washington (now US West Communications, Inc.) declined from 69.9% in 1975 to only 60.8% in 1988.[24] Several years later, in a study undertaken by Economics and Technology, Inc. for the Washington Utilities and Transportation Commission,[25] ETI found that the low plant utilization rates present in Washington State could be explained by the precipitous drop in the demand for Centrex service that began shortly after 1980.

ETI noted that OSP utilization levels would have remained essentially constant had the demand for Centrex (relative to PBX trunks) remained at pre-1980 levels. Unlike PBX systems that require a relatively small complement of loop pairs (PBX trunks) to serve a much larger number of individual PBX station lines (for a station:trunk ratio that is typically in the range of 8:1 to 12:1, depending upon overall system size and traffic patterns), Centrex service requires one loop pair for *each* station line since the switching function takes place at the telephone company central office. ETI speculated that Pacific Northwest Bell - Washington (PNB-WA, now US West Communications, Inc.) had continued to construct subscriber outside plant assuming that the same loop demand density would persist. Thus, PNB-WA continued to deploy plant to serve new commercial development *on the basis that at some point a customer at that business location would want to order Centrex.* This policy, of course, resulted in large quantities of unused ("spare") outside plant, whose costs would have to be spread to other services.[26]

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22. California Public Utilities Commission, D.83-12-025, 13 CPUC 2d, at 479.

23. *See* Lee L. Selwyn, Patricia D. Kravtin, and Paul S. Keller, *An Analysis of Outside Plant Provisioning and Utilization Practices of US West Communications in the State of Washington*, prepared for the Washington Utilities and Transportation Board, March, 1990, Attachment 8.

24. *Id.*

25. *Id.* at 9.

26. *Id.* at 22.

Thus, the excess loop capacity over and above basic demand growth attributable to Centrex, as described in the examples above, will create embedded costs that will not be accounted for in TSLRIC studies. ETI believes a significant portion of the "gap" may be explained by the amount of excess outside plant put in place for Centrex.

ILEC efforts to expand the market for additional residential lines and other discretionary services required the ILECs to design and construct far more extensive feeder and distribution infrastructures (and expend far greater aggregate capital investments) than otherwise would have been required to provision basic local exchange service.

Centrex is by no means the only loop-using service that imposes disproportionately high outside plant excess capacity requirements on ILEC plant. In fact, the outside plant capacity that would have been needed to support a "one line per household" feeder/distribution network is substantially smaller than that required when the ILEC offers to supply *additional* residential access lines on demand

Consider the following example. Suppose that on a given street there are a total of 80 dwelling units, and that there is one and only one residential access line connected to each of these units. The street is fully developed and there is no possibility that anyone will create any additional dwelling units. If the only service that the ILEC is to provide consists of these 80 residential access lines, then the size of the distribution cable for this street would be the next highest capacity above the 80 working lines plus approximately 5% (i.e., 4 pair) for maintenance spare. If the next largest cable is 100 pair, then that would be more than sufficient, and overall utilization of the distribution plant (defined as the ratio of working lines to total lines) would be 80%. If the plant were only used to support first line demand, the fill at relief should be even greater. Accounting only for breakage and maintenance spare, the objective fill for a one-loop per dwelling unit distribution network would be 95%. Obviously, the requirements would have differed if the ILEC had not been interested in expanding the market for additional line and other discretionary services.

Using the above example, suppose that on average 20% of residential customers order a second line; the LEC assumes that it cannot know, *a priori*, precisely which ones of the 80 primary-line customers will request an additional line, or how many such lines any given customer will order.[27] The LEC decides that, in configuring its distribution plant, it will provide an average of *two pairs* per dwelling unit to accommodate the core demand for the

27. In fact, the LEC can use market and demographic data to more accurately target capacity deployment to likely additional line demand, thereby reducing by a considerable amount that actual number of spare pairs that will be needed to support additional lines in any given distribution route.

primary access line as well as the discretionary demand for additional lines.[28] On this basis, it will require a minimum of 160 pairs (80 x 2) plus 8 (5% of 160) for maintenance/ administrative spare, or 168 in all. The next largest cable size is 200 pair, so that is what will be deployed. However, since the average demand for additional lines is 20%, only 96 out of the 200 available pairs will be in service (i.e., 80 first lines plus 16 additional lines), creating an overall utilization rate of 48% (96/200). Put another way, the inclusion of capacity capable of supporting additional residential access lines caused the overall size of the cable to increase and resulted in a drop in utilization from 80% to 48% overall.

The nature of the demand for primary and additional lines thus affects the outside plant capacity that is required to support the needs of each of these services. Only about 12.3% of residential telecommunications customers take additional access lines,[29] and there is a strong relationship between household income and the demand for this service.[30] The demand for additional lines is thus highly variable both with respect to the aggregate number of units as well as the specific locations where service will be requested. In order to accommodate this highly volatile and uncertain demand, ILECs have deployed far more capacity than would have been required to meet existing basic service demand.

From the foregoing discussion, it is apparent that the aggregate quantity of distribution plant would have been less, and its costs would have been lower, if it had been designed solely to support current levels of basic service demand. There is no argument, however, that the distribution infrastructure should be built to accommodate more than this core level of demand, because there is demand for additional services and because, due to the presence of economies of scale and scope in the provision of primary and additional residential access lines, the incremental costs of providing additional units of capacity *at the time of initial construction* are less than the cost per unit of additional line capacity that would be required were the feeder and distribution plant designed solely for the baseline basic service demand. In identifying that portion of outside plant additions needed to serve demand for basic network elements, it is necessary to identify and to exclude those costs associated with excessive amounts of embedded outside plant. motivated by an ILEC's competitive and strategic interests.

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28. Pacific Bell has indicated that this is the standard practice that it applies for buried distribution cable. Calif. PUC I.95-01-021, Deposition of W. Vowel, March 11, 1996, at 120-123. The Pacific Bell Cost Proxy Model (CPM) assumes distribution plant is engineered at a ratio of 2 lines per household for buried plant and 1.5 lines per household for aerial plant. Pacific Bell CPM Documentation at 9

29. *Percentage Additional Residential Lines for Households with Telephone Service*, FCC Industry Analysis Division, March 11, 1996.

30. See, Deposition of William L. Vowel, CPUC I.95-01-021, May 11, 1996, at Tr. 143-44.

ILEC strategic positioning in the market for other advanced and broadband digital services has resulted in the ILECs significantly increasing feeder facilities relative to those actually required to efficiently meet demand for basic services.

One explanation for the observed expansion of outside plant investment, as mentioned earlier, has been the growing interest among ILECs to acquire a broadband- and video-capable infrastructure. Historically, an ILEC's local exchange network was designed to supply primarily POTS-type services. Over time, an ILEC would have deployed an extensive embedded base of copper feeder and distribution plant that was presumably optimized for that purpose. Evidence adduced in the California PUC's Universal Service proceeding[31] indicates that, over the past seven years, Pacific Bell has made a number of significant revisions to its Company-wide guidelines governing the planning and provisioning of feeder facilities to support its efforts to provide advanced digital and broadband services. The use of these revised guidelines by Pacific's loop facilities planners has led to a significant overbuilding of feeder facilities relative to those actually required to efficiently meet demand for POTS services.

At the same time, however, the Company's local exchange network has become far less efficient and more costly than would have been expected for a forward-looking full service network integrating POTS and advanced digital services (as reflected in utilization factors for feeder plant), since the Company's loop planning guidelines and actual practices were constrained by its embedded copper network. Consequently, *Pacific's embedded local exchange network is not representative of a least-cost network for either POTS services alone, or for POTS with a broad range of other services on the network.*

Further evidence of ILECs' past investment practices is revealed in their depreciation studies, which aim at obtaining economic lives and depreciation rates for plant accounts, directly influenced by the accelerated pace of plant acquisitions and replacements. ILECs have argued that increased depreciation rates were necessary to support the replacement of older equipment (that had become technologically obsolete) with new, modern plant. However, much of that investment seems to be focused on services other than basic telephone service, such as advanced and broadband digital services. Current trends demonstrate that ILECs' strategic positioning in the market for advanced and broadband

31. California PUC, R.95-01-020/I.95-01-021, *Rulemaking and Investigation on the Commission's Own Motion into Universal Service and to Comply with the Mandates of Assembly Bill 3643.*

digital services has required the ILECs to significantly increase feeder facilities relative to those actually required to efficiently meet demand for POTS services.[32]

In fact, Pacific Bell's triennial Depreciation Studies submitted in 1985, 1988, and 1991 indicated the Company's intention to use the higher annual charges to support extensive modernization of its network. Each of the Depreciation Studies submitted by the Company in the time period spanning 1985 through 1991 includes numerous assertions that Pacific Bell must increase its depreciation rates in order to respond to technological advances and competitive pressures. Pacific also expressed a direct linkage between accelerated plant replacement and the introduction of new services.

Pacific Bell's 1985 depreciation filing, which also resulted in increases in Pacific Bell's depreciation rates, posits specific relationships between the rate increases and the rate of plant replacement. As is the case with the 1988 and 1991 filings, Pacific Bell attempted to justify its 1985 filing based on the prospect of "accelerated advances in technology."[33] The company argued that, *as a provider of a full range of telecommunications services*, it needed to invest in new technologies.[34]

The LECs should not be allowed to pass on such costs through additional charges for unbundled network elements required by potential interconnecting competitive service providers.

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32. This analysis confirms the results of a previous report produced by ETI, which concluded that many of the RBOCs were in fact disinvesting in plant in service. The report argued that the RBOCs were not adequately investing in basic service infrastructure. Lee L. Selwyn, Sonia N. Jorge, and Irena V. Tunkel, *Patterns of Investment by the Regional Bell Holding Companies: An Examination of the Sources of Financing and the Relative Performance of the Bell Operating Company and the non-BOC RBHC businesses,* ETI Research Report, January 1996. Our current analysis takes a further step and demonstrates that of those investments taking place, many are not for basic telephone service, but rather are for a network capable of providing a vast array of new telecommunications services.

33. Pacific Bell 1985 Depreciation Rate Study, October, 1984, Section I, p. 33.

34. *Id.* at 34.

5 CONCLUSION

This Study demonstrates that, contrary to the ILECs' efforts to portray their installed base of plant as consisting of technologically and economically obsolete equipment and facilities, the majority of the net rate base on ILEC books as of the end of 1995 was acquired on or after January 1, 1990. Moreover, our study demonstrates that a substantial portion of those post-1990 ILEC plant additions and retirements were attributed to the ILECs' pursuit of other strategic business goals and positioning for entry into new lines of competitive and often nonregulated businesses.

ETI's findings are consistent with several other recent studies of ILEC behavior and operations. For example, a recent study on depreciation policy by Baseman and Giesen demonstrated that the RBOCs' claims of a large depreciation problem appears to be motivated largely by their desire to enter non-telephony services.[35] In addition, the study found that the existing plant need not be replaced for efficient provision of basic local telephone service and that the RBOCs' proposals for accelerated depreciation would require users of basic telephone services to subsidize new services that many customers may not want.[36] Baseman and Giesen further demonstrated that the depreciation reserve deficiency, often argued by ILECs as a major burden on their ability to effectively compete, is in fact minimal and has decreased due to changes in FCC depreciation practices.

Another study, one conducted by Hatfield Associates, also reached conclusions similar to those of this analysis.[37] The Hatfield study found that the "gap" between the 'bottoms-up' economic costs and the 'tops-down' revenue requirement consists of a number of elements, including expenses associated with providing services to end-users, a small

35. Baseman, Kenneth C. and Harold Van Gieson. "Depreciation Policy in the Telecommunications Industry: Implications for Cost Recovery by the Local Exchange Carriers," MiCRA, prepared on behalf of MCI Telecommunications Corp., December 1995, at 3.

36. *Id.*

37. Hatfield Associates, Inc., "The Cost of Basic Network Elements: Theory, Modelling and Policy Implications," prepared for MCI Telecommunications Corporation, March 29, 1996.

amount of economic overhead, and large amounts of overbuilt plant and excess overhead."[38] Specifically, the study identified five distinct revenue requirement components of the "gap": overbuilt plant, customer operations, corporate operations, inefficiencies, and underdepreciation. Consistent with our analysis, the Hatfield study concluded that overcapacity was the largest component of the "gap". Indeed, the study identified that excess ILEC plant capacity was due to investments in broadband services, interLATA official service networks, and loops.

Our findings in this study are robust and consistent with these other studies made using different methodologies. With this evidence, it is critical that the Commission make clear that the costs that are relevant in the determination of the Total Service Long Run Incremental Costs for unbundled network functions must exclude all historic and strategic components that are not relevant in the determination of forward-looking incremental costs. Costs associated with premature retirement of the installed base, with the acquisition of high-function assets for use in developing new strategic lines of business, and with corporate activities that are unrelated to the provision of essential basic network elements must not be imposed upon new local exchange service providers through the pricing of these elements. Similarly, ILEC strategic investments in facilities specifically designed to provide other services such as advanced broadband, or excess facilities targeted at future demand, must also be excluded. While the ILECs are free to make such strategic investments or to acquire capacities and capabilities that will support their long term business goals, these costs are not relevant to and should not be considered when determining interconnection or unbundled network elements rates.

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38. *Id.* at 35.

Appendix A — VINTAGE ANALYSIS WORKSHEETS

Table A1	Ameritech
Table A2	Bell Atlantic
Table A3	BellSouth
Table A4	NYNEX
Table A5	Pacific Telesis
Table A6	SBC Communications
Table A7	US West
Table A8	SNET
Table A9	Development of Survivorship Curve

APPENDIX A WILL BE PROVIDED UPON REQUEST

Appendix B — COMPOSITION ANALYSIS WORKSHEETS

Table B1	Ameritech
Table B2	Bell Atlantic
Table B3	BellSouth
Table B4	NYNEX
Table B5	Pacific Telesis
Table B6	SBC Communications
Table B7	US West

APPENDIX B WILL BE PROVIDED UPON REQUEST

Appendix C | UTILIZATION ANALYSIS WORKSHEETS

Table C1	Ameritech
Table C2	Bell Atlantic
Table C3	BellSouth
Table C4	NYNEX
Table C5	Pacific Telesis
Table C6	SBC Communications
Table C7	US West

APPENDIX C WILL BE PROVIDED UPON REQUEST

APPENDIX D